2.3.4 Hells Canyon Reservoir (RM 272.5 to 247):

The Hells Canyon Reservoir segment (RM 272.5 to 247) includes Hells Canyon Reservoir from the outflow of Oxbow Dam to Hells Canyon Dam (Figure 2.3.29). This segment is also fairly small and fast flowing with a total volume of 170,000 acre-feet and an average retention time of 4 days (Table 2.3.32). The reservoir has a surface area of about 2,500 acres and approximately 56 miles of shoreline (IPCo, 1999a). Flow into Hells Canyon Reservoir is almost exclusively the outflow of Oxbow Reservoir. Pine Creek, which flows directly into the reservoir near the Oxbow Dam, constitutes less than 1 percent of the total inflow. Flow and residence time within the reservoir are controlled by the releases from Oxbow Reservoir and the releases from Hells Canyon Dam. Hells Canyon Reservoir is not operated for flood control. Due to its relatively small size, highly controlled inflow and outflow, and short residence time, water management and water quality concerns in this segment are well correlated with the reservoir boundaries.

Table 2.3.32 Physical characteristics of Hells Canyon Reservoir.

Date Closed	1967
Full Pool (feet msl)	1,688
Minimum Pool (feet msl)	1,678
Total Volume (acre-feet)	170,000
Surface Area (acres)	2,412
Mean Depth (feet)	70
Length (river miles)	25
Mean Width (feet)	1000
Shoreline (miles)	56
Average Retention Time (days)	4

2.3.4.1 INTRODUCTION

For a discussion on the effect of impoundments within the SR-HC TMDL reach see Section 2.1.1.4

While most of the processes discussed in Section 2.1.1.4 can result in reduced water quality, impoundments can also act to improve water quality in downstream segments. Brownlee Reservoir, located in the farthest upstream position in the Hells Canyon Complex, acts as a sink for both sediment and nutrients within the Hells Canyon Complex and downstream river segments; deep-water releases also act to lower water temperatures in downstream segments. To a lesser degree, Hells Canyon Reservoir acts in this same capacity and reduces sediment and attached pollutants that might otherwise enter downstream segments. While these changes in transport can act to improve water quality, the agencies prefer to prevent the initial pollutant loading into a water system than to depend on instream treatment systems (ODEQ, 1999).

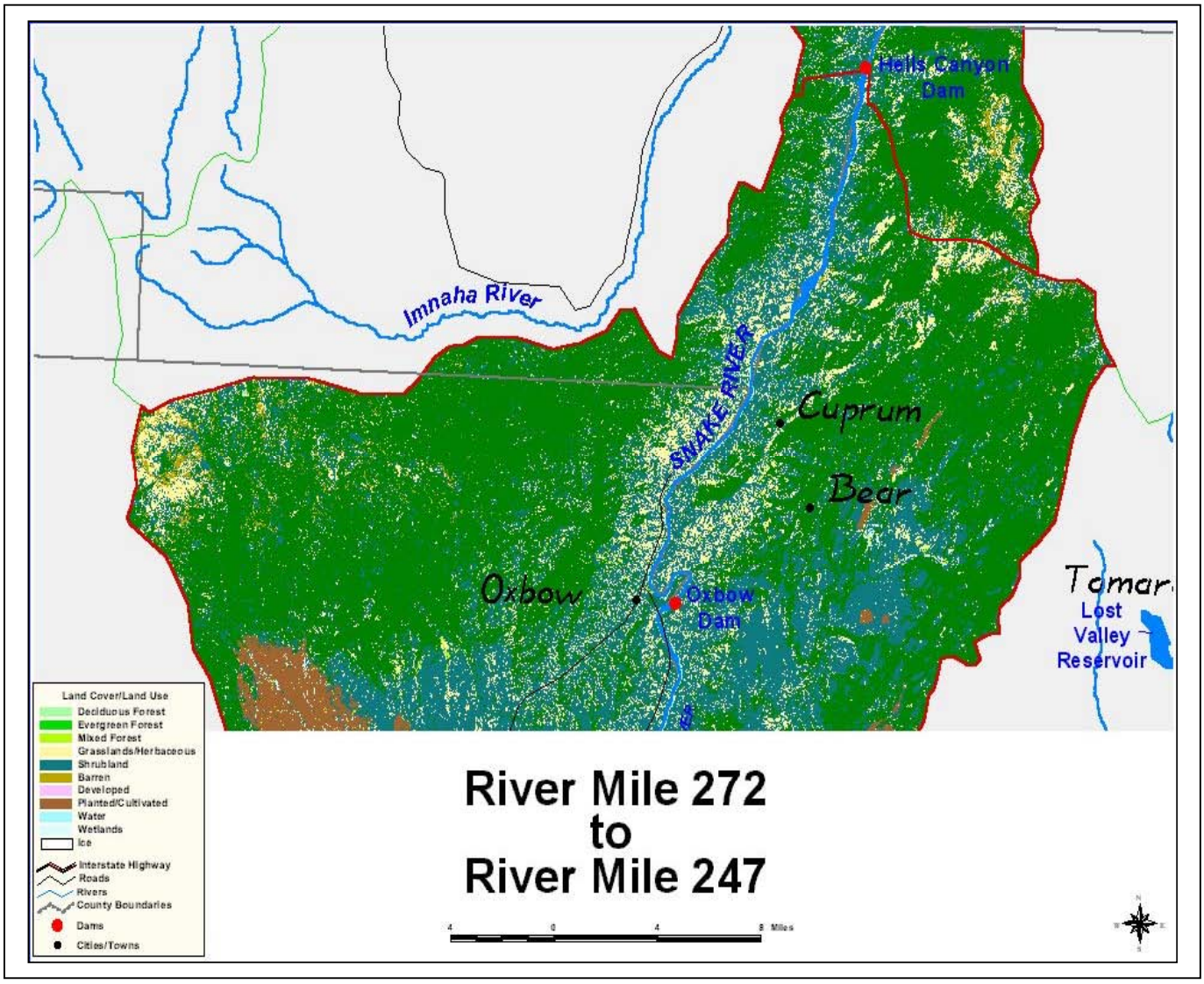

Figure 2.3.29 Hells Canyon Reservoir segment of the Snake River – Hells Canyon reach.

2.3.4.2 WATER QUALITY CONCERNS/STATUS

General Information

The waters in the Hells Canyon Reservoir segment (RM 272.5 to 247) of the SR-HC TMDL reach are listed as water quality limited due to mercury and elevated temperatures (Table 2.3.33). A detailed examination of the data available to this assessment has identified that the listing for mercury depends on data and interpolation from upstream sources.

Table 2.3.33 Listing information for the Hells Canyon Reservoir segment (RM 272.5 to 247) of the Snake River - Hells Canyon TMDL reach.

Segment	Idaho Listed Pollutants	Idaho Designated Beneficial Uses
Snake River: RM 272.5 to 247 Hells Canyon Reservoir	Not listed	Cold water aquatic life primary contact recreation domestic water supply special resource water
Segment	**Oregon Listed Pollutants**	**Oregon Designated Beneficial Uses**
Snake River: RM 335 to 260 Brownlee Reservoir Oxbow Reservoir Upper half of Hells Canyon Reservoir (Powder Basin)	Mercury, temperature	Public/private domestic water supply industrial water supply irrigation water, livestock watering salmonid rearing and spawning* resident fish and aquatic life water contact recreation wildlife and hunting fishing, boating, aesthetics hydropower
Snake River: RM 260 to 188 Lower half of Hells Canyon Reservoir Downstream Snake River (Grande Ronde Basin)	Mercury, temperature	Public/private domestic water supply industrial water supply irrigation water, livestock watering salmonid rearing and spawning* resident fish and aquatic life water contact recreation wildlife and hunting fishing, boating, aesthetics anadromous fish passage commercial navigation and transport

* Salmonid spawning within these drainage basins is most likely to occur within the tributaries to the SR-HC TMDL reach where flow and substrate conditions are favorable to support such uses. Therefore, the salmonid spawning beneficial use designation and its accompanying water quality targets will apply to those tributaries so designated. As these tributaries are not interstate waters, and salmonid spawning use support is a localized habitat issue, state-specific targets for salmonid spawning will apply to those areas of the tributaries designated for salmonid spawning.

Both of the pollutants and their potential affects on the Hells Canyon Reservoir segment (RM 272.5 to 247) are described in more detail in the following sections.

Listed Pollutants and Designated Beneficial Uses

Table 2.3.33 summarizes the listed pollutants and designated beneficial uses for the Hells Canyon Reservoir segment (RM 272.5 to 247). A more detailed description of each of the

designated beneficial uses is included in Section 2.2.2. A more detailed description of the listed pollutants and the assessment process is located in Section 3.0 through 3.7.

Salmonid rearing as well as resident fish are designated as beneficial uses in this segment. The primary salmonid species in this segment are rainbow trout and mountain whitefish however; bull trout have been documented in the Hells Canyon Reservoir. Resident fish include such cool and warm water fish as bass, crappie, and catfish. The resident cool and warm water fish form the dominant fish community in the Hells Canyon Reservoir segment (RM 272.5 to 247).

Summary and Analysis of Existing Water Quality Data

Mercury.

The Hells Canyon Reservoir segment (RM 272.5 to 247) of the SR-HC TMDL reach is listed as water quality limited due to a human fish consumption advisory for mercury from the State of Oregon (Appendix D).

General Concerns. In addition to the general information available in Section 2.2.4.2, methylation of mercury is of specific concern within the reservoir environment. Low dissolved oxygen levels and the presence of a substantial amount of organic material near the sediment/water interface can result in higher rates of methylmercury production, as hydrocarbon materials from the organic matter are available to bond with elemental mercury. Methylmercury represents a significantly greater threat for bioconcentration and accumulation than elemental or mineralized mercury compounds as it is much more soluble in water and therefore much more mobile within both the physical reservoir system and the metabolic systems of living organisms living in or utilizing the water.

Water Quality Targets. See Section 2.2.4.2 and Table 2.2.2.

Common Sources. See Section 2.2.4.2. The majority of mercury loading to Hells Canyon Reservoir is from mercury processed through Brownlee and Oxbow Reservoirs.

Historical Data. There are no known historical mercury data for the Hells Canyon reservoir segment (RM 272.5 to 247) of the SR-HC TMDL reach available in either an anecdotal or numeric format.

Current Data. There are no known current data for Hells Canyon Reservoir, such as those cited for the Upstream Snake River (RM 409 to 335), Brownlee Reservoir (RM 335 to 285), and Downstream Snake River segment (RM 247 to 188) of the SR-HC TMDL reach.

Table 2.3.34 Mercury monitoring for the Hells Canyon Reservoir segment (RM 272.5 to 247) of the Snake River - Hells Canyon TMDL reach.

Segment	Mercury Monitoring Dates	Source
Hells Canyon Reservoir (RM 272.5 to 247)	None	None (see sources for Brownlee and Upstream segments)

Segment Status. Because the only mercury data available that is applicable to the Hells Canyon Reservoir segment (RM 272.5 to 247) are from studies conducted in upstream and downstream waters, some interpolations of transport have been made. The following facts and assumptions were applied in the interpolation process.

- The outflow from Brownlee Reservoir represents the predominant source of water for Oxbow Reservoir (greater than 99%).
- The outflow from Oxbow Reservoir represents the predominant source of water for the Hells Canyon Reservoir segment (greater than 99%).
- The majority of sediments delivered to Oxbow and then Hells Canyon Reservoir come from the Brownlee Reservoir outflow.
- Due to the depositional nature of Brownlee Reservoir the sediments carried in the outflow are heavily weighted toward smaller, finely divided particles and organic matter. There would be some further but much more limited deposition of larger particles in Oxbow Reservoir.
- These smaller particles and associated organic matter represent a substantial adsorption and transport pathway potential for mercury from Brownlee Reservoir into Oxbow Reservoir and on into Hells Canyon Reservoir.
- Because there are no other significant inflows to either Oxbow Reservoir or Hells Canyon Reservoir, the major source of mercury in Hells Canyon Reservoir is assumed to be Brownlee Reservoir and upstream tributary inflows.

Therefore, mercury concentrations in Hells Canyon Reservoir are not expected to exceed those observed in Brownlee or the upstream Snake River segments. In a conservative assessment, mercury concentrations in Hells Canyon Reservoir can be assumed to be less than or equal to those observed in Brownlee Reservoir.

Upstream data show impairment of the designated beneficial use of fishing. Available upstream data and information demonstrate a high level of concern for the wildlife and hunting designated beneficial use due to observed fish tissue methylmercury concentrations. Collection of water column data is required to determine the status of cold water aquatic life, salmonid rearing, resident fish and aquatic life, domestic water supply designated beneficial uses.

Temperature.

The Hells Canyon Reservoir segment (RM 272.5 to 247) of the SR-HC TMDL reach is listed for temperature due to violations of the Oregon and Idaho water quality standards, including the numeric and narrative criteria for salmonid rearing/cold water aquatic life, resident fish and aquatic life.

General Concerns. See Section 2.2.4.6.

Water Quality Targets. See Section 2.2.4.6 and Table 2.2.2.

Common Sources. See Section 2.2.4.6.

Historical Data. There are no known historical temperature data for this segment available in either an anecdotal or numeric format.

Current Data. Current temperature data available for the Hells Canyon Reservoir segment (RM 272.5 to 247) include monitoring of both inflow and mainstem values. Water temperature data for some areas of the drainage extend back to the 1990's and represent a variety of high and low annual precipitation levels. Daily maximum, mean and minimum water temperatures are recorded at the inflow to Hells Canyon Reservoir, but collection frequency and period of record varies in other areas of the reservoir.

Table 2.3.35. Surface water temperature monitoring information for the Hells Canyon Reservoir segment (RM 272.5 to 247) of the Snake River - Hells Canyon TMDL reach.

Segment	Temperature Monitoring Dates	Source
Hells Canyon Reservoir (RM 272.5 to 247)	1990 to 1999 1973 to 1982	IPCo, 2000c US EPA STORET data, 1998a

Segment Status. The primary source of water inflowing to Hells Canyon Reservoir is from Oxbow Reservoir, immediately upstream (more than 99% of the total inflow). The average summer temperature of inflowing water is 19°C (66°F). The average winter season temperature of inflowing water is approximately 5°C (41°F). Due to the short residence time, the temperature of water moving downstream through Hells Canyon Reservoir increases only minimally (less than 3°C (5.4°F) over the length of the reservoir). As there are relatively few anthropogenic sources of elevated temperature in the Hells Canyon Reservoir area outside of the hydropower facilities themselves, temperature increases within the reservoir are most likely due in most part to solar radiation and high summer air temperatures. Daily maximum and minimum water temperatures show a wider overall range and greater total variance as distance downstream from Oxbow Dam increases.

Pine Creek flows into Hells Canyon Reservoir below Oxbow Dam. Water temperatures in Pine Creek exhibit some seasonal temperature variability, with annual maximum temperatures reaching 20°C (68°F), usually in July or August; and annual minimum temperatures dropping to ~4°C (39°F) in the winter months of December or January. As the relative flow contribution of Pine Creek is quite small (less than 1% of the total inflow), changes in temperature within Hells Canyon Reservoir due to Pine Creek inflows are assumed to be minimal.

Available data show exceedences of temperature criteria throughout the surface waters of the SR-HC TMDL reach during the months of June, July, August and September. Cold water aquatic life and salmonid rearing designated uses are supported in the Hells Canyon Reservoir segment (RM 272.5 to 247) due to the presence of cold water refugia.

Total Dissolved Gas.

General Concerns. See Section 2.2.4.7.

Water Quality Targets. See Section 2.2.4.7 and Table 2.2.2.

Common Sources. See Section 2.2.4.7.

Historical Data. There are no historical total dissolved gas data available.

Current Data. The current data available for total dissolved gas have been collected by IPCo. Spill tests were conducted at Brownlee Dam on June 4, 1998 at a spill level of 39,000 cfs. The total dissolved gas levels observed from spilling through the upper gates averaged 114 percent of saturation while spill through the lower gates averaged 127.7 percent of saturation. Spill from Brownlee Dam was identified as the largest influence on total dissolved gas concentrations within Oxbow and Hells Canyon reservoirs (IPCo, 1998c, 1999b, 1999f). However, while elevated total dissolved gas concentrations from spill at Brownlee Dam have been observed to have an effect on the total dissolved gas in Oxbow and Hells Canyon reservoirs, the effect is not observed to extend to the Downstream Snake River segment (RM 247 to 188) of the SR-HC TMDL reach.

Segment Status. Exceedences of the total dissolved gas target of less than 110 percent occur in both Oxbow and Hells Canyon reservoirs (as related to spill from Brownlee Dam in excess of 2,000 to 3,000 cfs).

Elevated total dissolved gas levels from spills through the Hells Canyon Complex reservoirs may be a significant factor in resident and anadromous fish survival both in the reservoirs and downstream in the Snake River. A study by IPCo determined that in general, spills in excess of 2,000 to 3,000 cfs result in total dissolved gas levels that exceed the state standard of less than 110 percent of saturation both within the reservoirs and downstream in the Snake River (IPCo, 1998c, 1999b, 1999f).

During the period of no spill, the state standard of less than 110 percent of saturation total dissolved gas within the Snake River below Hells Canyon Dam was always met (IPCo, 1999b).

2.3.4.3 DATA GAPS

See Section 2.4

2.3.4.4 POLLUTANT SOURCES

See Section 2.5

Point Source

The only known permitted point source that discharges directly to Hells Canyon Reservoir is the permit for discharge from Oxbow Dam. The Oxbow Dam permit applies to miscellaneous discharge water only, not water released directly through the dam and the mining permit applies to water discharged from a settling pond that is dry most of the year. The Alta Gold Mine (formerly the Iron Dyke copper and gold mine) located at Homestead is not currently operating and does not discharge to the Snake River.

Nonpoint Source

Nonpoint sources discharging to the mainstem Snake River in the SR-HC TMDL reach include agricultural, recreational, urban/suburban, and forestry land use, as well as ground water and natural and background loading.

Agricultural.

A minor amount of the agricultural land (less than 0.1%) within the SR-HC TMDL reach is located in the drainage area of Pine Creek that flows into the Hells Canyon Reservoir segment (RM 272.5 to 247) of the SR-HC TMDL reach. No known agricultural return flows have been identified within the Hells Canyon Reservoir segment of the SR-HC TMDL reach. Grazing occurs to a limited extent in some areas within this segment but animal densities are minimal.

Recreational.

Due to its relative proximity to populated urban areas and other recreational opportunities within the Hells Canyon Complex, Hells Canyon Reservoir is a major destination site year-round. Water-based recreational activities peak in the summer season with heavy use observed between Memorial Day weekend and Labor Day weekend, when the reservoir is used by many boaters, swimmers, campers and anglers. The average use of the reservoir (May 1997 through October 1998) is estimated at 120,902 visitor hours annually. Peak use during a week has been estimated at 10,864 visitor hours (July 4th), and monthly peak use levels estimated at 32,592 visitor hours (July). Camping and bank-fishing use occurs at substantial levels (IPCo, 2000b; HCNRA, 1998a and 1998b, 1999a and 1999b).

Urban/Suburban.

A minor amount of the urban/suburban land within the SR-HC TMDL reach is located in the drainage area of the Hells Canyon Reservoir segment (RM 272.5 to 247). Rural residential housing supported by septic systems is present in and around the city of Oxbow but densities are minimal.

Ground Water.

Many natural springs and ground-water inflows have been observed in the Hells Canyon Reservoir segment (RM 272.5 to 247) of the SR-HC TMDL reach. These inflows occur in the tributary drainages and the reservoir system, entering both above and below the water level in many locations. Subsurface recharge from irrigation water use is estimated to be minimal in the Hells Canyon Reservoir segment due to low irrigation water usage in this area. Natural ground-water inputs are estimated to dominate over subsurface recharge in most areas of this segment.

Background and Natural Contributions.

The natural sources discussed above are known to be present to some degree in the Hells Canyon Reservoir segment (RM 272.5 to 247) of the SR-HC TMDL reach. However, the occurrence of natural sources of mercury is more prevalent in tributaries to the Upstream Snake River segment (RM 409 to 335) and the Brownlee Reservoir segment (RM 335 to 285) than in the Hells Canyon Reservoir segment (RM 272.5 to 247).

2.3.4.5 POLLUTION CONTROL EFFORTS

See Section 2.6.